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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

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60/528225
120903

INVENTOR(S)

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
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☐ *Additional inventors are being named on the ____ separately numbered sheets attached hereto*

TITLE OF THE INVENTION (280 characters max)

SPRING TRAVEL LIMITOR FOR OVERRUNNING DECOUPLER

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ENCLOSED APPLICATION PARTS *(check all that apply)*

☒ Specification *Number of Pages* 12

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☐ Application Data Sheet. See 37 CFR 1.76

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Respectfully submitted,

SIGNATURE [signature]

Date 12/09/2003

TYPED or PRINTED NAME Kevin S. MacK nzi

REGISTRATION NO. *(if appropriate)* 45,639

Docket Number: 19357-095336

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By: Karen E. Pesta

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Attorney Docket No. 19357-095336

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SPRING TRAVEL LIMITOR FOR OVERRUNNING DECOUPLER

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to a crankshaft and belt drive assembly of an automotive vehicle, and more particularly, to a decoupling mechanism for the allowing the belt drive assembly to operate temporarily at a speed other than the crankshaft.

Description of the Related Art

It is widely known in an automotive vehicle engine to transfer a portion of the engine output to a plurality of belt driven accessories utilizing an endless serpentine belt. Typically, each component includes an input drive shaft and a pulley coupled to a distal end of the drive shaft for driving engagement with the belt. An example of such a belt driven accessory is an alternator.

It is also known to provide a decoupler operatively coupled between the pulley and the alternator to allow the alternator drive shaft to "overrun" or rotate at a faster speed than the pulley and to allow the speed of the pulley to oscillate with respect to the alternator drive shaft due to oscillations in the engine speed.

Examples of decouplers are disclosed in the United States Patent 6,083,130, issued to Mevissen et al. on July 4, 2000 and the United States Patent 5,139,463, issued to Bytzek et al. on August 18, 1992.

It remains desirable to provide a decoupler that is easier to manufacture and has better durability over conventional decoupler designs.

SUMMARY OF THE INVENTION

According to one aspect of the invention, a decoupler assembly is provided for transferring rotary movement between an engine driven crankshaft and a serpentine belt. The decoupler includes a hub configured to be assembled to the shaft. The hub has a helical first slot formed therein. A pulley is coupled to the hub. A carrier is mounted on the hub and includes a helical second slot formed therein, as well as an anti-ramp up boss formed thereon. A thrust plate is associated with the pulley and carrier and has a slot formed therein. A torsion spring extends between a hub end retained in the helical first slot and a carrier end retained in the helical second slot for transferring torque between the hub and carrier. The anti-ramp up boss travels within the slot formed in the thrust plate for limiting the travel of the torsion spring.

BRIEF DESCRIPTION OF THE DRAWINGS

Advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Figure 1 is a front view of an engine incorporating a decoupler according to one aspect of the invention;

Figure 2 is a perspective view of a decoupler assembly;

Figure 3 is a perspective view of a slotted thrust plate and carrier with an anti-ramp up boss;

Figure 4 is a perspective view of the thrust plate and carrier in a torque lock-up position;

Figure 5 is a perspective view of the thrust plate and carrier in an anti-ramp up position;

Figure 6 is a perspective view of an alternative embodiment of a decoupler assembly;

Figure 7 is a perspective view of a tabbed thrust plate and carrier with an anti-ramp up slot according to the alternative embodiment;

Figure 8 is a perspective view of the tabbed thrust plate and carrier in a torque lock-up position;

Figure 9 is a perspective view of the tabbed thrust plate and carrier in an anti-ramp up position;

Figure 10 is a sectional view of the decoupler assembly of the present invention;

Figure 11 is a sectional view of the decoupler assembly of the present invention;

Figure 12 is a perspective view of the carrier and spring of the decoupler assembly of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to figure 1, an engine for an automotive vehicle is generally indicated at 10. The engine 10 includes a crankshaft 12 driving an endless serpentine belt 14, as commonly known by those having ordinary skill in the art. The engine 10 also includes a belt driven accessory 16 driven by the belt 14. Described in greater detail below, a decoupler assembly 20 is operatively assembled between the belt 14 and the belt driven accessory 16 for automatically decoupling the belt driven accessory 16 from the belt 14 when the belt 14 decelerates relative to the belt driven accessory 16 and allowing the speed of the belt 14 to oscillate relative to the belt driven accessory 16. Additionally, a detailed description of the structure and function of a decoupler assembly can be found in applicant's United States Patent 6,083,130, which issued on July 4, 2000 and is incorporated herein by reference in its entirety.

Referring to Figures 2, 10, and 11 the decoupler assembly 20 includes a hub 22 having opposite first 24 and second 26 ends and a generally cylindrical body 28 extending

axially therebetween. The body 28 includes opposite inner 30 and outer 32 surfaces extending between the first 24 and second 26 ends of the hub 22. The inner surface 30 includes a plurality of inner threads 33 adjacent the first end 24 for fixedly securing the hub 22 to a drive shaft 15 from the belt driven accessory 16. A reduced diameter portion 34 is formed in the first end 24. The reduced diameter portion 34 includes an outer mounting surface 36 having a smaller outer diameter than the body 28. An abutment surface (not shown) opposite the second end 26 extends generally radially between the outer mounting surface 36 and the body 28. An annular thrust plate 39 is seated on the outer mounting surface 36 adjacent the abutment surface 38. The thrust plate 39 preferably includes a slot 43 formed on its peripheral edge to mate with a carrier 75, as will be discussed in more detail below.

A socket 40 is formed in the second end 26 for receiving a suitable tool therein for rotatably threading the hub 22 onto the drive shaft 15. An annular first flange 41 extends radially outwardly from the body 28 adjacent the second end 26. The first flange 41 includes an outer flange surface 42 having a larger outer diameter than the body 28. An annular surface 44 extends generally radially between the body 28 and the outer flange surface 42 opposite the second end 26. A generally helical first slot 46 is formed in the annular surface 44 defining a first locating surface 48 therein.

A generally cylindrical pulley 50 is rotatably journaled to the hub 22. More specifically, the pulley 50 extends between opposite first 52 and second 54 ends. The pulley 50 includes an inner surface 56 extending between the first 52 and second 54 ends. A ball bearing member 57 is coupled between the pulley 50 and the hub 22. The bearing member 57 includes an inner race 58 fixedly secured to a portion of the outer mounting surface 36 and an outer race 59 secured to a portion of the inner surface 56 adjacent the first end 52 of the pulley 50. A plurality of ball bearings 55 is engaged between the inner 58 and outer 59 races

of the bearing member 57. The thrust plate 39 is preferably secured in place between the inner race 58 and hub 22 when assembled. A cylindrical bushing 60 is journal mounted between the pulley 50 and the first flange 41. The bushing 60 includes a sleeve wall 62 extending between a portion of the inner surface 56 adjacent the second end 54 and the outer flange surface 42 of the first flange 41. A bushing flange 64 extends radially inwardly from the sleeve wall 62 and abuts the annular surface 44 in the first flange 41.

The pulley 50 includes an outer periphery 66 with a plurality of V-shaped grooves 68 formed therein for engaging and guiding the belt 14.

Referring to Figures 2 and 10, a one-way clutch assembly 70 is operatively coupled between the hub 22 and the pulley 50. The clutch assembly 70 includes a clutch spring 71 and a carrier 75. The clutch spring 71 includes a plurality of helical coils 72 extending between a bent or hooked proximal end 73 and an opposite distal end 74. Preferably, the clutch spring 71 is formed from an uncoated, spring steel material and has a non-circular cross-section to improve frictional contact. Most preferably, the cross-section of clutch spring 71 is rectangular or square. The clutch spring 71 is fitted into frictional engagement with the inner surface 56 of the pulley 50. Preferably, a lubricant is applied to minimize wear between the clutch spring 71 and the inner surface 56 of the pulley 50.

The carrier 75 is mounted on the hub 22. The carrier 75 is generally ring shaped and extends axially between opposite first and second sides 76, 78. An anti-ramp up boss 77 is formed on the first side 76 of the carrier 75 and is configured to mate with the slot 43 formed in the thrust plate 39, when assembled. The anti-ramp up boss prevents ramp- up or the relative movement of a torsion spring 90 relative to the carrier 75, as will be discussed in more detail below. A hooked slot 84 is formed in the second side 78 of the carrier 75 and is configured to retain the hooked proximal end 73 of the clutch spring 71. A generally helical

second slot 86 is formed in the second side 78 of the carrier 75 defining a second locating surface 88 generally opposing the first locating surface 48 formed in the annular surface 44.

Referring to Figures 2 and 10, a helical torsion spring 90 extends between hub 92 and carrier 94 ends. The torsion spring 90 is axially compressed between the first 48 and second 88 locating surfaces for transferring torque between the hub 22 and the carrier 75. More specifically, the hub end 92 of the torsion spring 90 is retained in the first slot 46 of the hub 22. Similarly, the carrier end 94 of the torsion spring 90 is retained in the second slot 86 in the second side 78 of the carrier 75. Axial forces due to the compression of the torsion spring 90 retains the first side 76 of the carrier 75 in abutting engagement with the thrust washer 39. The torsion spring 90 also allows relative movement between the carrier 75 and the hub 22 to accommodate changes in the speed of the pulley 50 due to generally oscillating changes in the operating speed of the engine. The torsion spring 90 and the clutch spring 71 are coiled in opposite directions. In prior applications of decouplers, as the torsion spring 90 winds and unwinds due to changes in engine speed, the spring 90 presses against a stop face 99 associated with the slot 86 formed in the carrier to transmit torque from the engine. As the driving force associated with the engine reverses, as in an over run condition, the spring 90 attempts to move away from the stop face 99 as the only forces holding it in place are friction forces between the spring and carrier and the load contained by the spring 90. Such movement of the spring can cause excessive wear of the stop face and lead to failure of the assembly.

To alleviate the above outlined problem, the anti-ramp up boss 77 travels within the slot 43 of the thrust plate 39 as the thrust plate 39 and carrier 75 rotate relative to each other to accommodate changes in speed of the pulley 50. The anti- ramp up boss 77 travels between opposing sides of the slot 43 which define boundaries for a torque lock up position and a ramp-up position. The torque lock up position of the carrier 75 and thrust plate 39 is

shown in Figure 4 and is defined as the position in which torsional deflection of the spring 90 due to rotation is stopped by the interaction of the anti-ramp up boss 77 with one side 192 of the slot 43 formed in the thrust washer 39. The anti-ramp up position is shown in Figure 5 and is defined as the position in which the anti-ramp up boss 77 engages the second side 193 of the slot 43 formed in the thrust washer 39 preventing the spring 90 from backing away from the stop face 99 associated with the carrier 75.

When assembled, the spring 90 is placed about the hub 22 and attached at the slot 46, as described above. The carrier 75 and thrust plate 39 are aligned such that the anti-ramp up boss is within the slot 43 of the thrust washer 39. The carrier 75, thrust plate 39 , and spring 90 are aligned and then attached to the hub 22. The bearing member 57 is then attached to hold the thrust washer 39 in place with respect to the hub 22.

A cap 100 is assembled to a flange 102 formed in the pulley 50 for preventing contaminants from entering the decoupler assembly 20 and for retaining the lubricant within the decoupler assembly 20.

In operation, the engine 10 is started and the pulley 50 is accelerated and rotated in a driven direction by the belt 14 driven by the engine 10. Acceleration and rotation of the pulley 50 in the driven direction relative to the hub 22 creates friction between the inner surface 56 of the pulley 50 and preferably all of the coils 72 of the clutch spring 71. It should be appreciated that the clutch spring 71 will function even where at the onset at least the end coil 74 of the clutch spring 71 is frictionally engaged with the inner surface 56 of the pulley 50. The clutch spring 71 is helically coiled such that the friction between the inner surface 56 of the pulley 50 and at least the end coil 74 would cause the clutch spring 71 to expand radially outwardly toward and grip the inner surface 56 of the pulley 50. Continued rotation of the pulley 50 in the driven direction relative to the hub 22 would cause a generally exponential increase in the outwardly radial force applied by the coils 72 against the inner

surface 56 until all of the coils 72 of the clutch spring 71 become fully brakingly engaged with the pulley 50. When the clutch spring 71 is fully engaged with the inner surface 56, the rotation of the pulley 50 is fully directed toward rotation of the drive shaft 15 of the belt driven accessory 16. Additionally, centrifugal forces help to retain the clutch spring 71 in braking engagement with the inner surface 56 of the pulley 50.

The rotational movement of the carrier 75 in the driven direction is transferred to the hub 22 by the torsional spring 90 such that generally the carrier 75, thrust washer 39, hub 22, and the drive shaft 15 from the belt driven accessory 16 rotate together with the pulley 50. At a point where the maximum design torque (or spring twist angle) has been reached, the anti-ramp up boss 77 engages the slot 43 of the thrust washer 39 in the torque lock up position described above. The torque lock up position is a limit for travel of the boss 77 that oscillates between the torque limiting and anti-ramp up positions during normal operation. The boss 77 may contact the anti ramp-up side regularly during normal operation while seldom contacting the torque limiting side . Additionally, the torsional spring 90 resiliently allows relative movement between the carrier 75 and the hub 22 to accommodate oscillations in the speed of the pulley 50 due to corresponding oscillations in the operating speed of the engine 10.

When the pulley 50 decelerates, the hub 22 driven by the inertia associated with the rotating drive shaft 15 and the rotating mass within the belt driven accessory 16 will initially "overrun" or continue to rotate in the driven direction at a higher speed than the pulley 50. More specifically, the higher rotational speed of the hub 22 relative to the pulley 50 causes the clutch spring 71 to contract radially relative to the inner surface 56 of the pulley 50. The braking engagement between the clutch spring 71 and the pulley 50 is relieved, thereby allowing overrunning of the hub 22 and drive shaft 15 from the belt driven accessory 16 relative to the pulley 50. The anti-ramp up boss 77 of the carrier 75 engages the slot 43 of the thrust plate 39 in the anti-ramp up position described above, preventing the spring 90 from

damaging the stop face 99 associated with the carrier 75. The coils 72 may remain frictionally engaged with the inner surface 56 while the pulley 50 decelerates relative to the clutch assembly 70 and the hub 22. The coils 72 of the clutch spring 71 begin to brakingly reengage the inner surface 56 as the pulley 50 accelerates beyond the speed of the hub 22.

Referring to Figures 6-9 there is shown an alternative embodiment of the decoupler assembly 20 of the present invention. The alternative embodiment is identical in all respects to the first embodiment with the exception of the carrier 175 and thrust plate 139. The carrier 175 of the alternative embodiment contains an anti-ramp up slot 177 that mates with a tab 143 formed on the thrust plate 139, as best seen in Figure 7. Essentially the slot 43 on the thrust plate 39 and boss 77 of the carrier 75 of the first embodiment have been transposed to the slot 177 of the carrier 175 and the tab 143 of the thrust plate 139 in the alternative embodiment. As with the previously described first embodiment, the tab 143 and slot 177 have toque lock up and anti-ramp up positions as seen in Figures 8, and 9 that correspond to those defined above. With respect to the first and alternative embodiments, the first embodiment is more sensitive to peak loads, as the area of contact of the stop face 99 is limited to the thickness of the thrust plate 39, as opposed to the alternative embodiment where the contact area can be selected by the size of the tab 143 to lower stress associated with the stop face 99.

The invention has been described in an illustrative manner, and it is to be understood that the terminology, which has been used, is intended to be in the nature of words of description rather than of limitation. Many modification and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced other than as specifically described.

What is claimed is:

1. A decoupler assembly for transferring torque between a shaft and a drive belt, the decoupler assembly comprising:

a hub configured to be assembled to the shaft, the hub having a helical first slot formed therein;

a pulley coupled to the hub;

a carrier mounted on the hub, the carrier including a helical second slot formed therein and an anti-ramp up boss formed thereon;

a thrust plate associated with the pulley and carrier, the thrust plate having a slot formed therein;

a torsion spring extending between a hub end retained in the helical first slot and a carrier end retained in the helical second slot for transferring torque between the hub and carrier,

the anti-ramp up boss traveling within the slot formed in the thrust plate for limiting the travel of the torsion spring.

2. A decoupler assembly for transferring torque between a shaft and a drive belt, the decoupler assembly comprising:

a hub configured to be assembled to the shaft, the hub having a helical first slot formed therein;

a pulley coupled to the hub;

a carrier mounted on the hub, the carrier including a helical second slot formed therein and an anti-ramp up slot formed thereon;

a thrust plate associated with the pulley and carrier, the thrust plate having a tab formed therein;

a torsion spring extending between a hub end retained in the helical first slot and a carrier end retained in the helical second slot for transferring torque between the hub and carrier,

the tab traveling within the slot formed in the carrier for limiting the travel of the torsion spring.

ABSTRACT

A decoupler assembly for transferring rotary movement between an engine driven crankshaft and a serpentine belt. The decoupler includes a hub configured to be assembled to the shaft. The hub has a helical first slot formed therein. A pulley is coupled to the hub. A carrier is mounted on the hub and includes a helical second slot formed therein, as well as an anti-ramp up boss formed thereon. A thrust plate is associated with the pulley and carrier and has a slot formed therein. A torsion spring extends between a hub end retained in the helical first slot and a carrier end retained in the helical second slot for transferring torque between the hub and carrier. The anti-ramp up boss travels within the slot formed in the thrust plate for limiting the travel of the torsion spring.

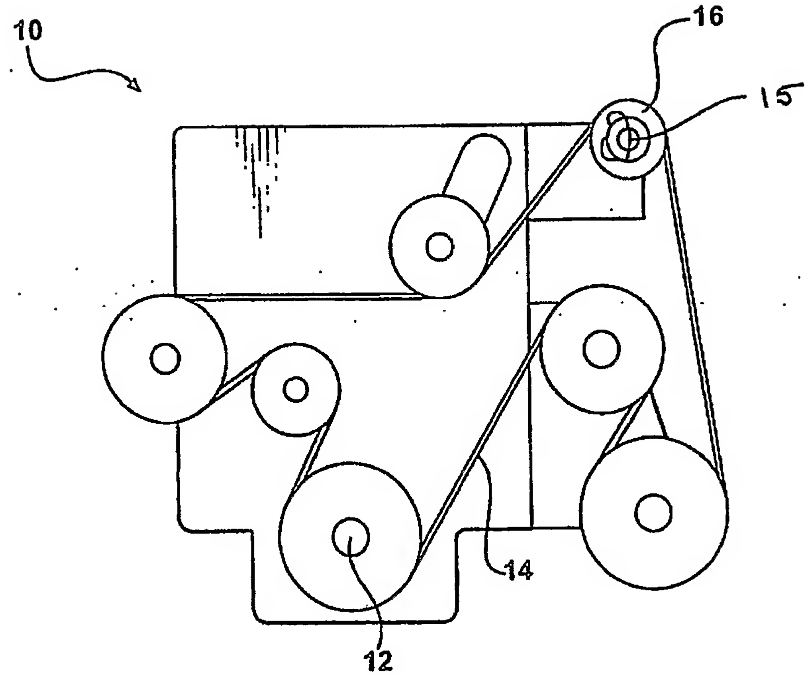

FIGURE 1

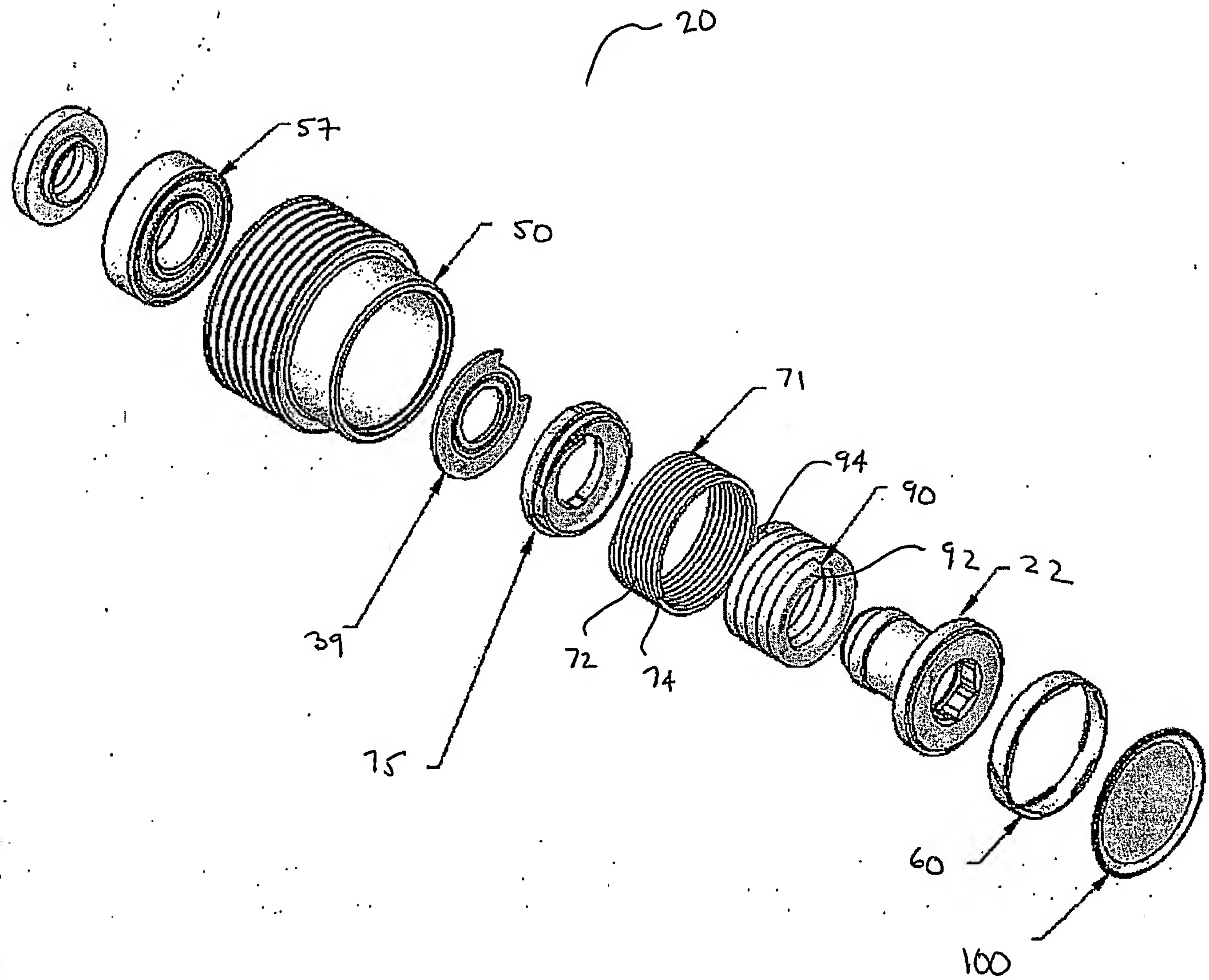

FIGURE 2

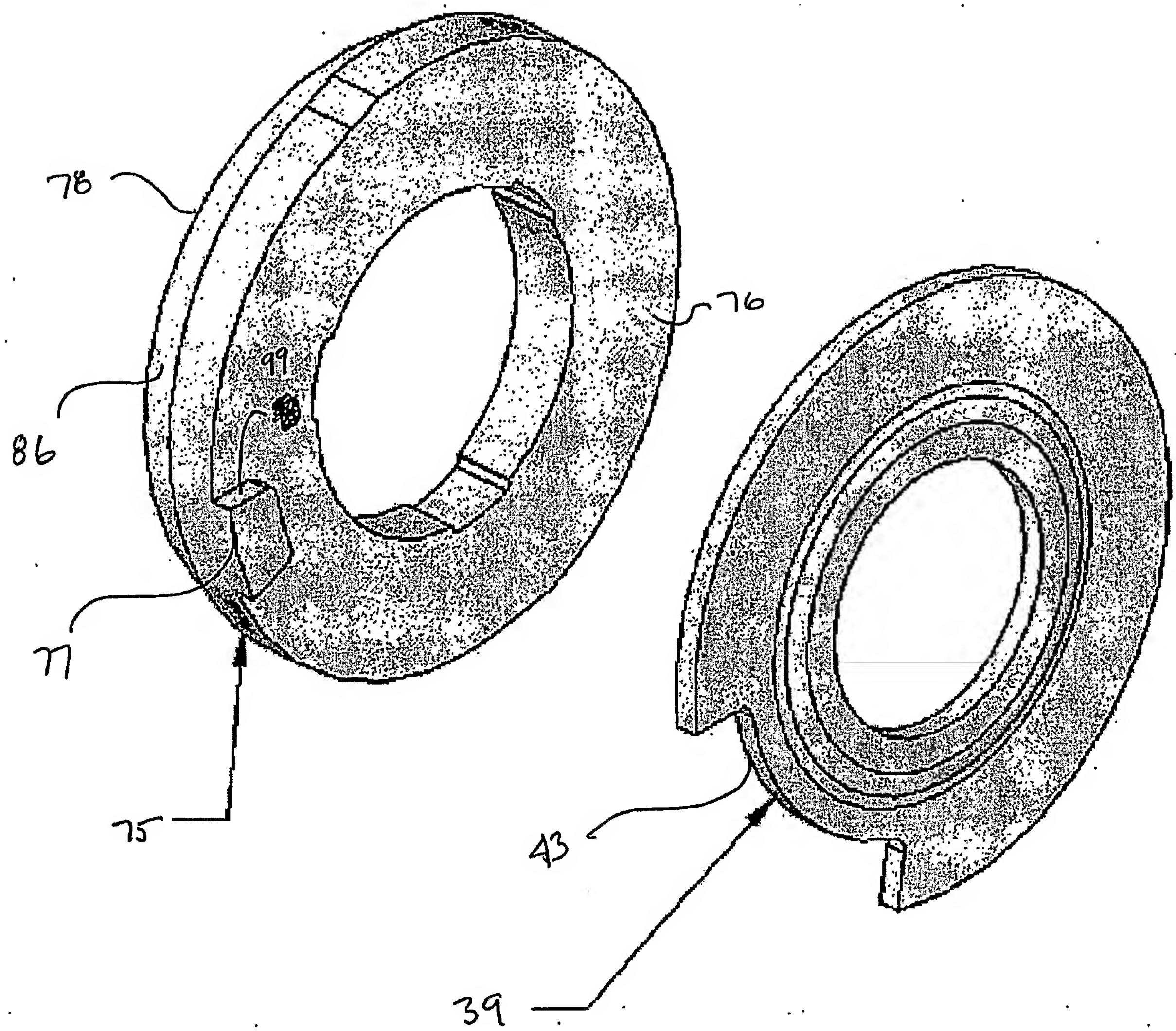

FIGURE 3

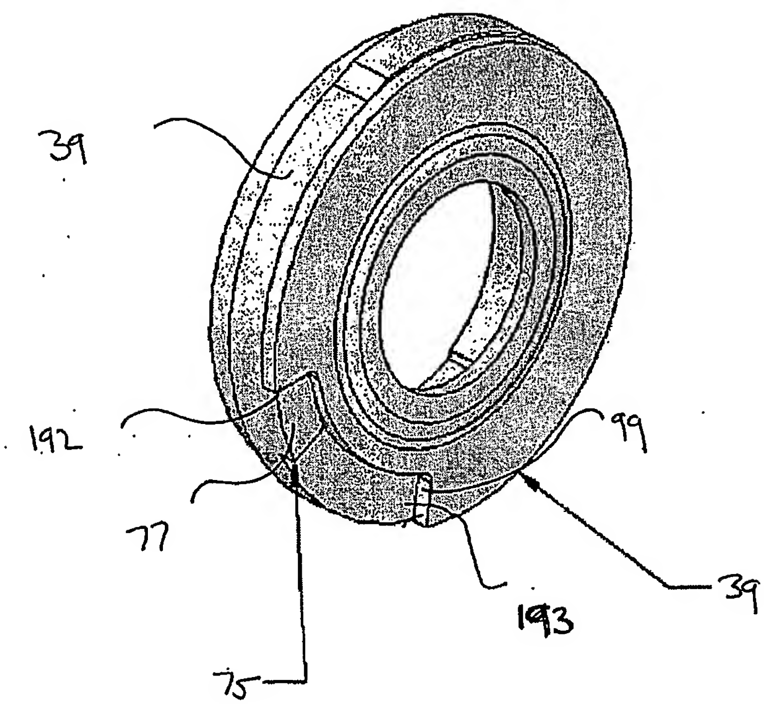

FIGURE 4

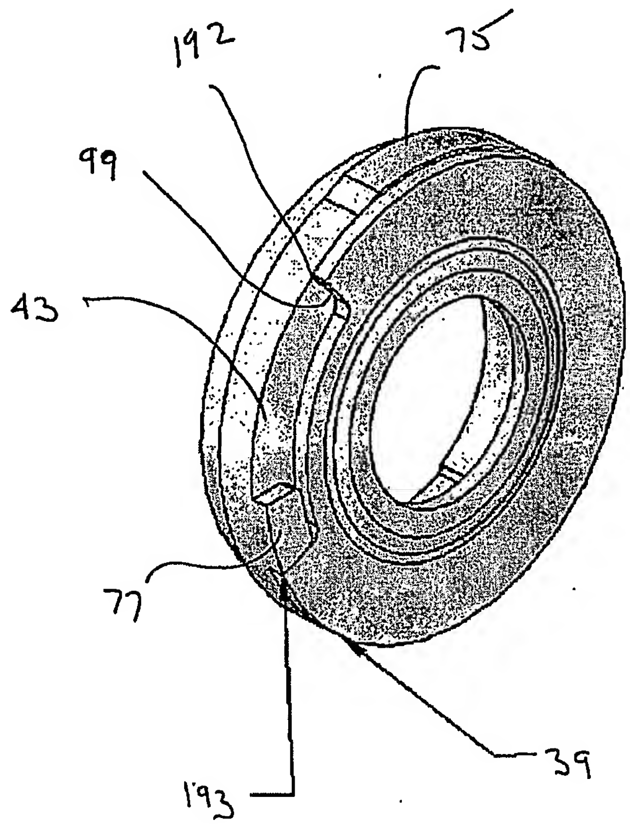

FIGURE 5

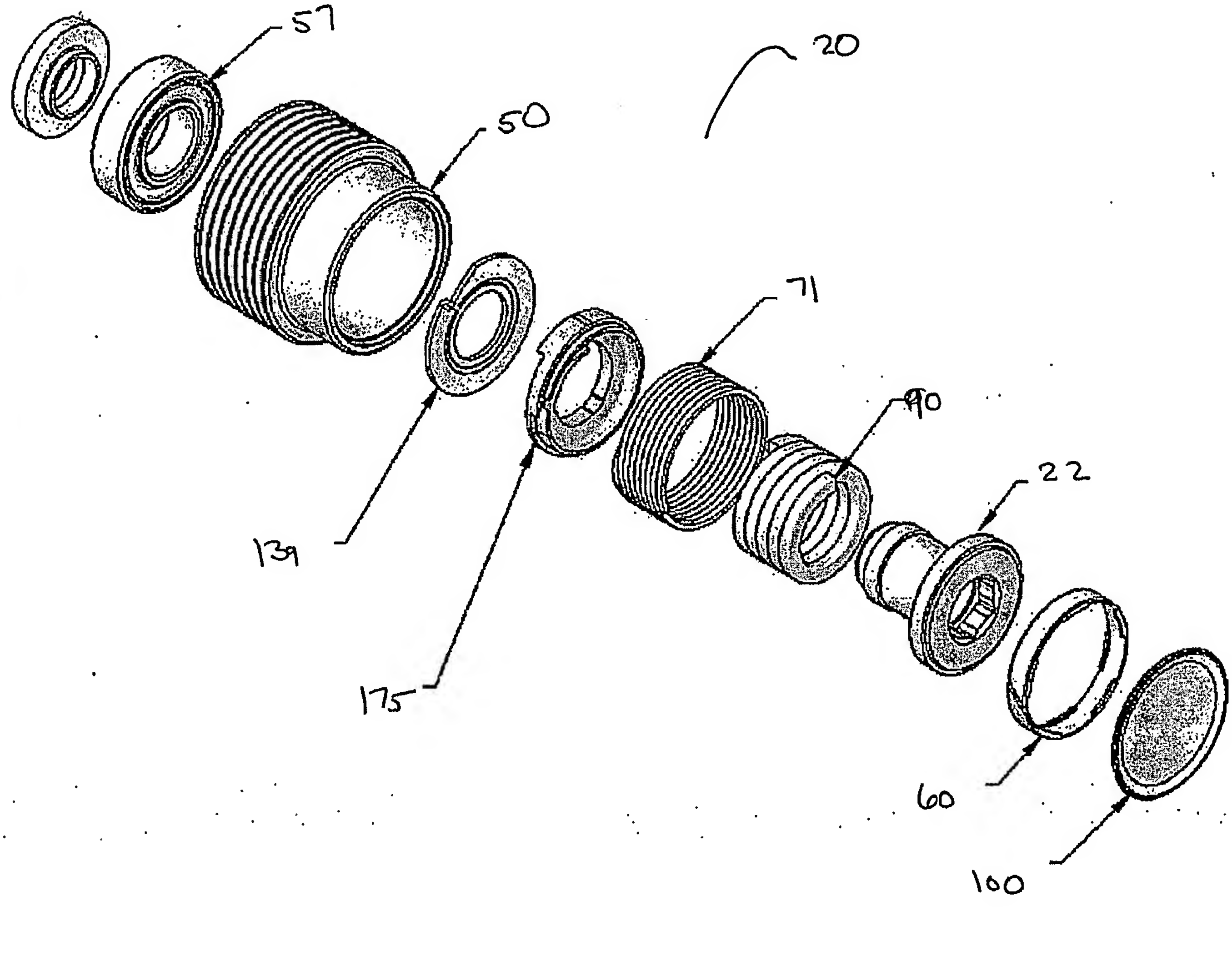

FIGURE 6

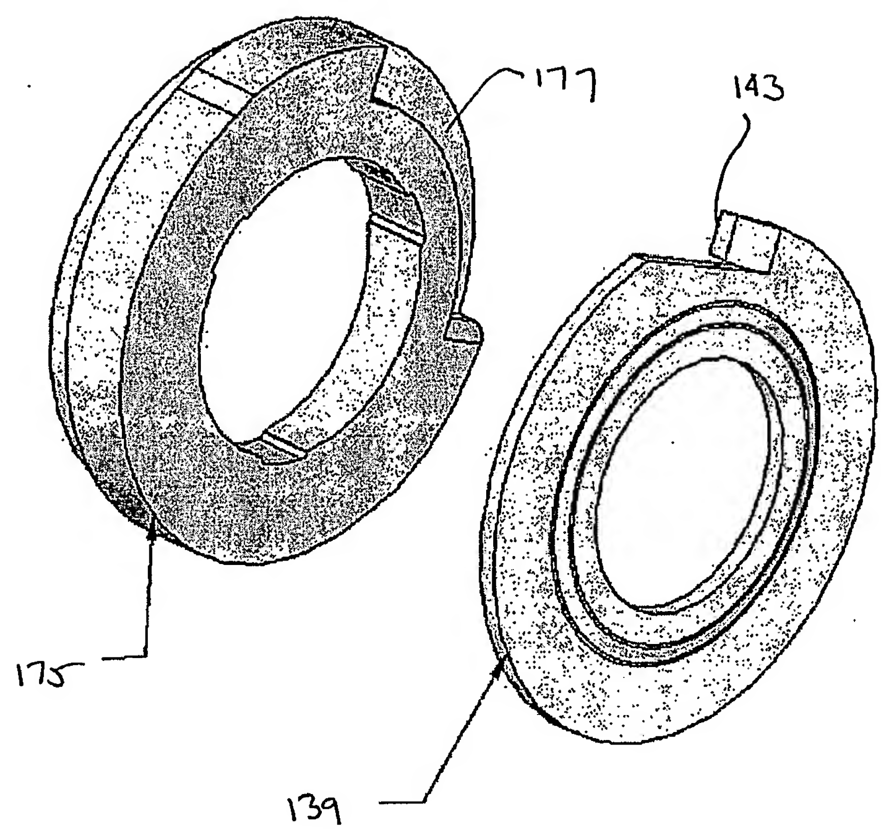

FIGURE 7

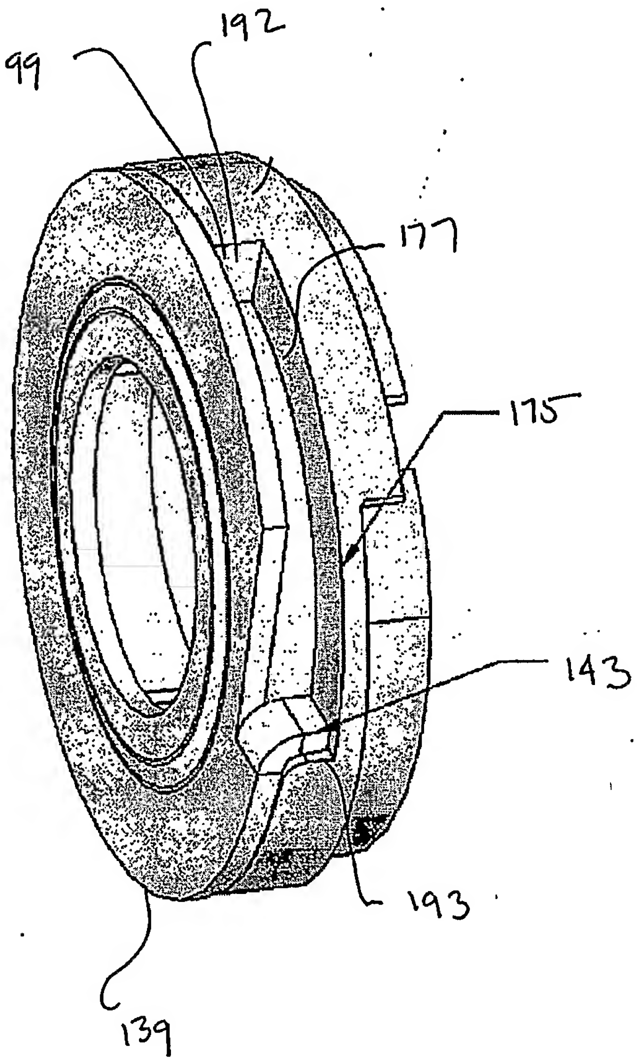

FIGURE 8

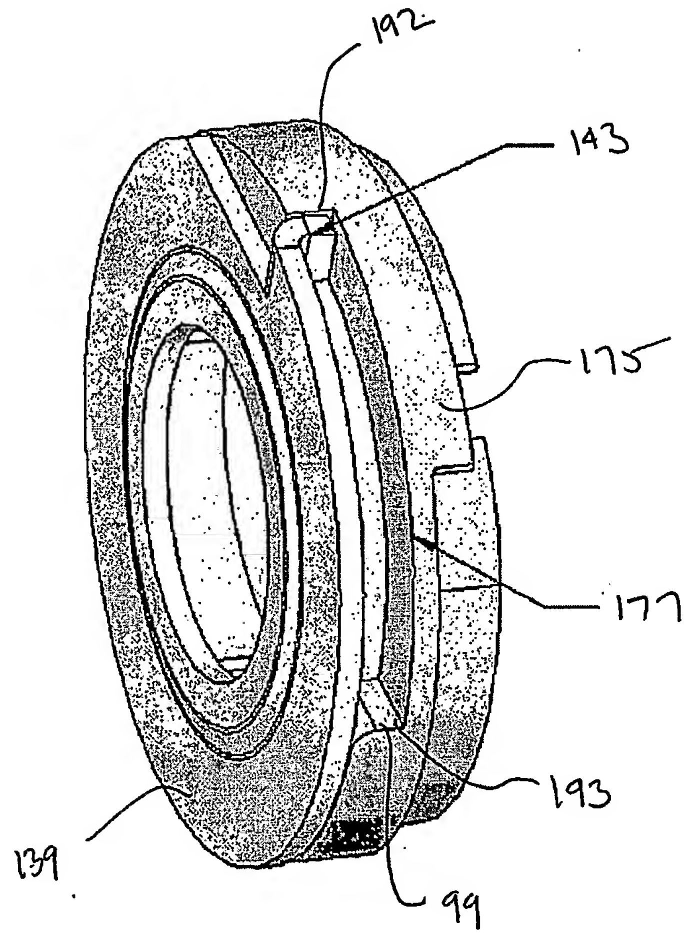

FIGURE 9

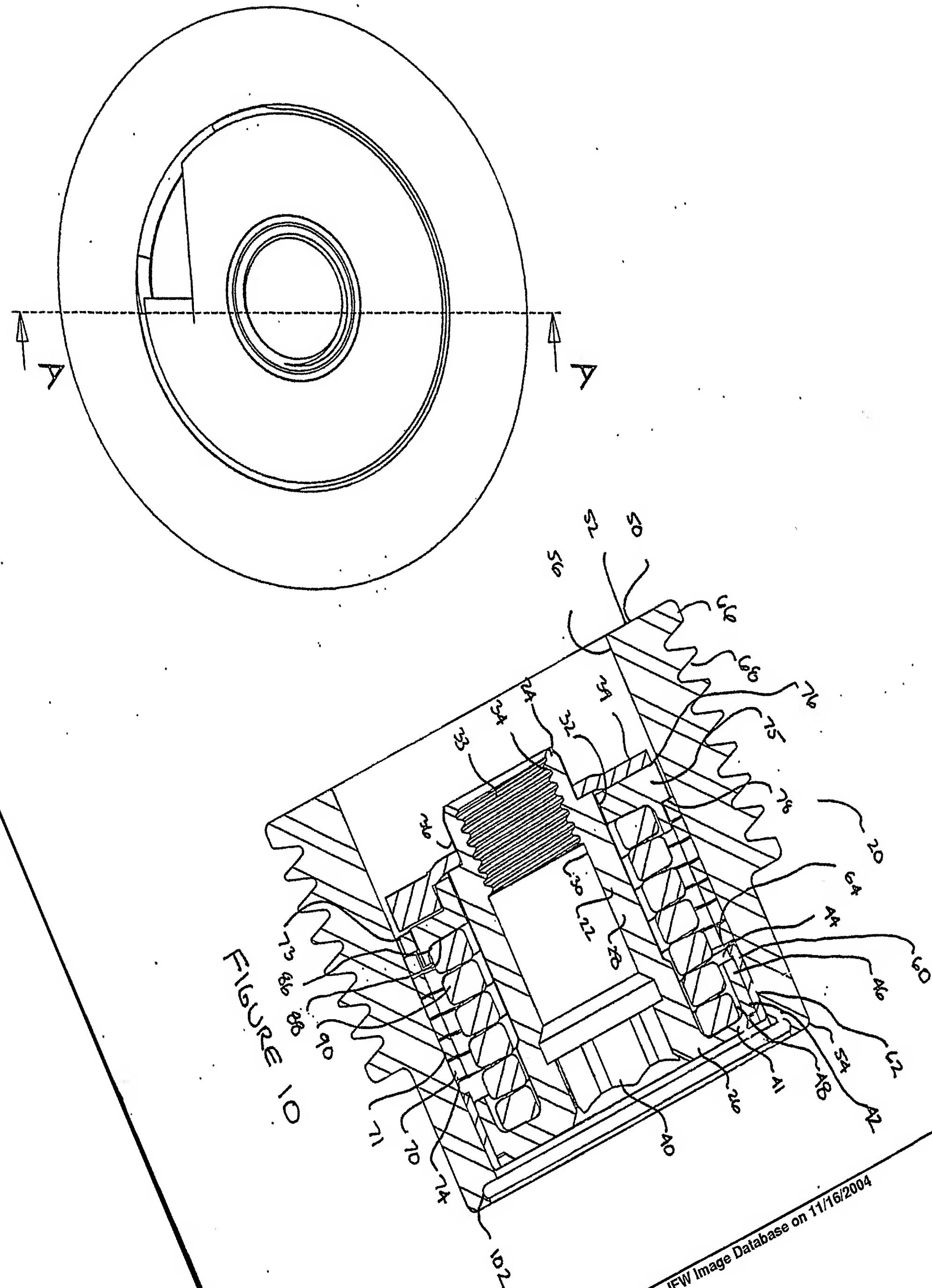
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FIGURE 10

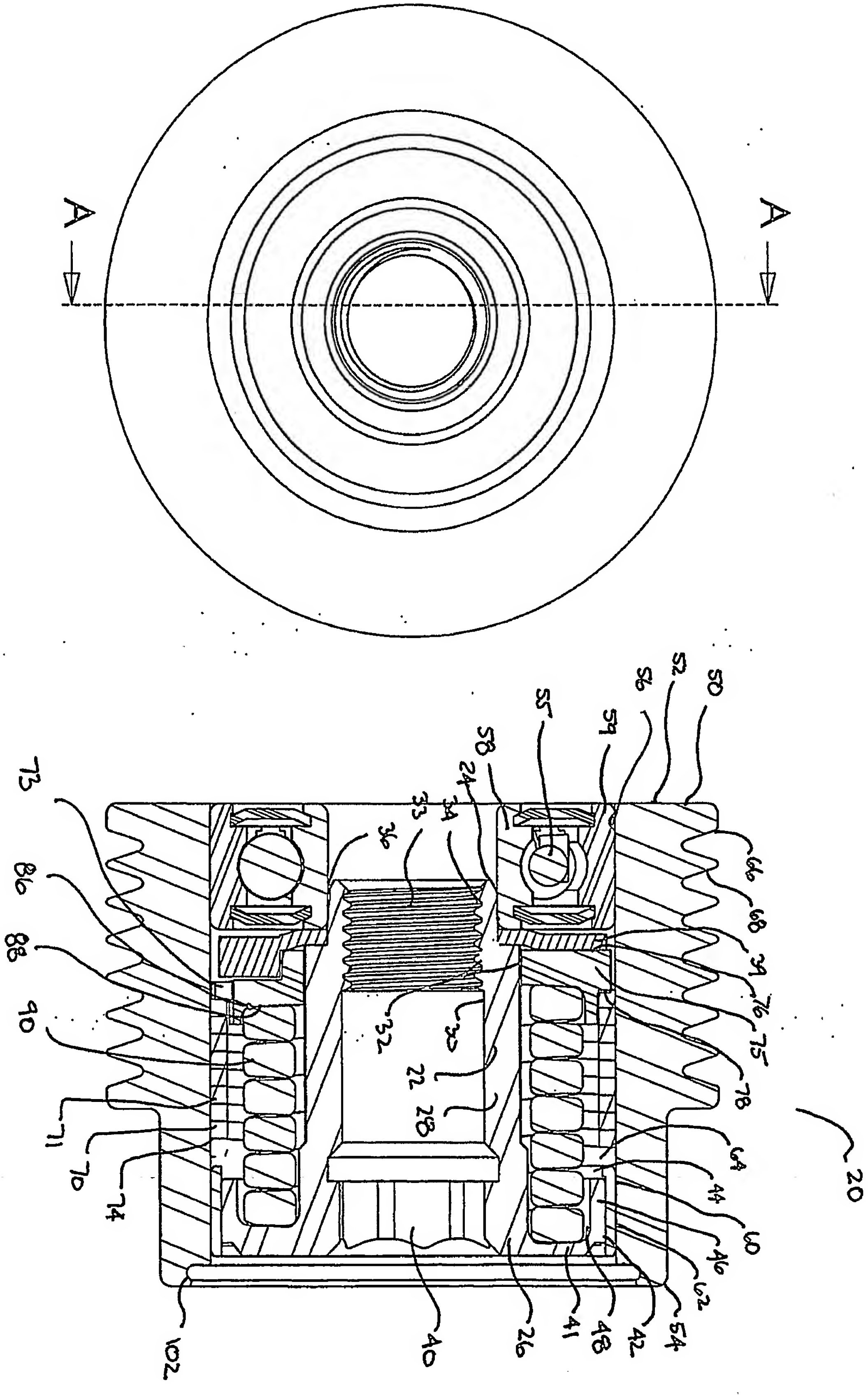
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FIGURE 11

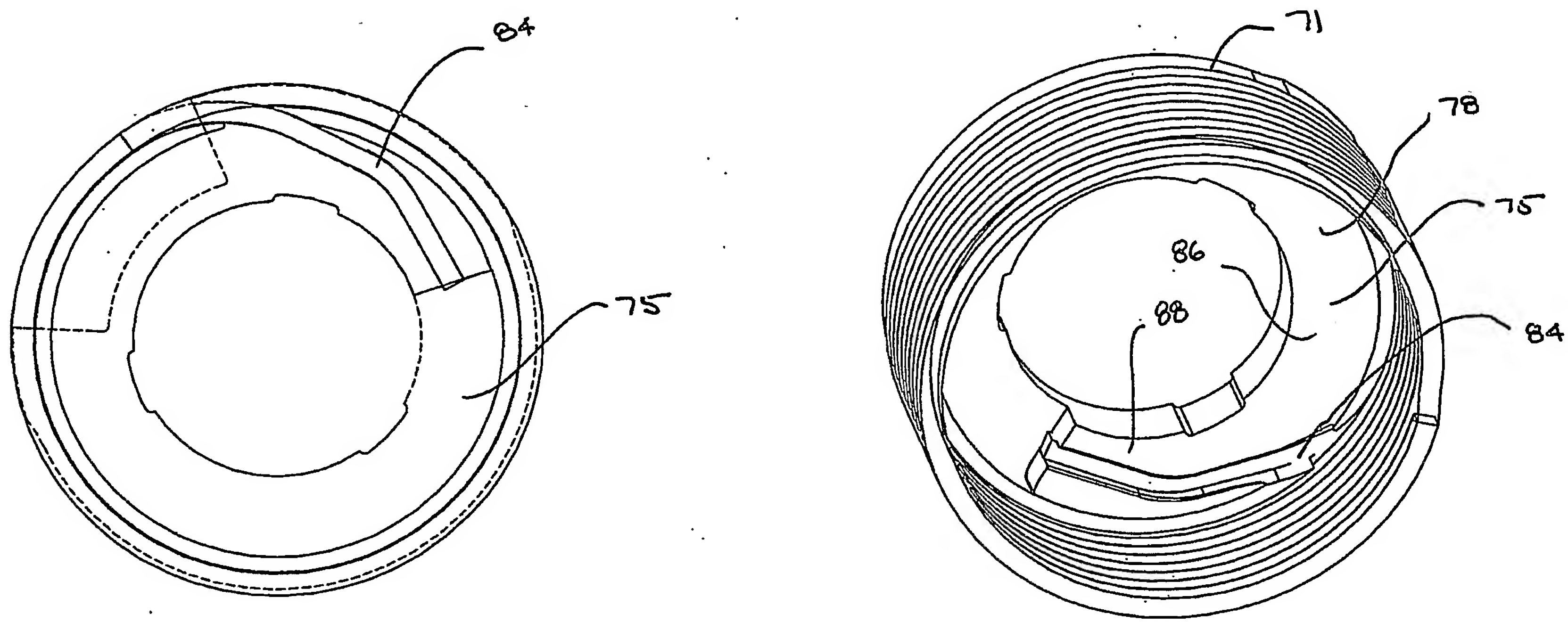

FIGURE 12